Exhibit A

Physics of Semiconductor Devices

SECOND EDITION

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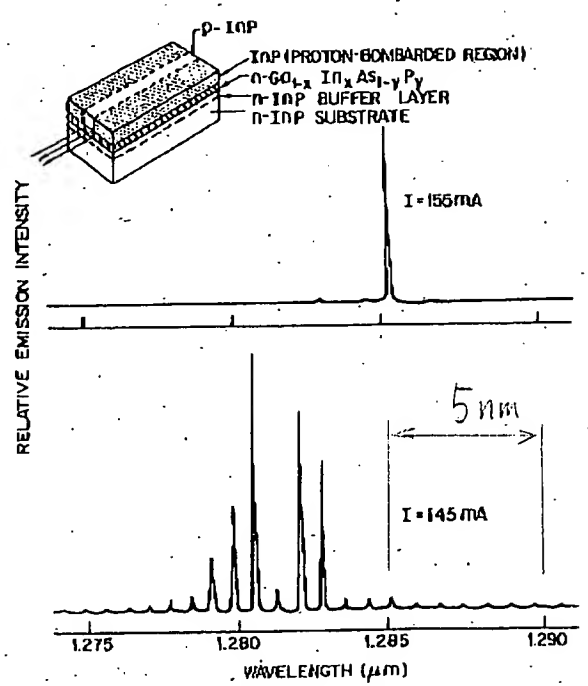

Fig. 50 High-resolution emission spectra for a DH InP–GaInAsP laser. (After Foyt, Ref. 44.)

Figure 50 shows a high-resolution spectral distribution for a proton-bombarded, stripe-geometry, InP–GaInAsP DH laser. At a current just above the threshold (145 mA) quite a few emission lines, about evenly spaced with a separation of $\Delta\lambda \simeq 7.5$ Å, exist. At a higher current ($I =$ 155 mA), there is a strong tendency for the spectrum to become single-moded with only one emission peak near 1.285 μm. These emission lines belong to the longitudinal modes that will now be derived.

With reference to Fig. 29*a*, the basic mode selection for the z direction (longitudinal direction) arises from the requirement that only an integral number m of half-wavelengths fits between the reflection planes. Thus

$$m\left(\frac{\lambda}{2\bar{n}}\right) = L \tag{59}$$

$$m\lambda = 2L\bar{n} \tag{60}$$

where $\bar{n}$ is the refractive index in the medium corresponding to the wavelength λ and L is the length of the semiconductor. The separation $\Delta\lambda$ between these allowed modes in the z direction is the difference in the